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## Processing Crime Scenes

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2018

### **document version**

Publisher's PDF, also known as Version of record

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### **citation for published version (APA)**

van den Eeden, C. A. J. (2018). *Processing Crime Scenes: Psychological Influences on Forensic Inferences*. [PhD-Thesis - Research and graduation internal, Vrije Universiteit Amsterdam].

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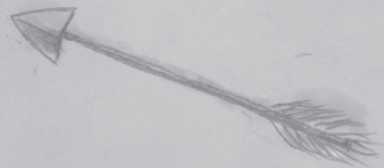
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# Chapter 1

## Psychological influences on forensic inferences

Parts of this chapter are translated and extended versions from a Dutch chapter in a Legal Psychology textbook:

Van den Eeden, C. A. J., & De Gruijter, M. (2017). Psychologische invloeden op forensisch-technisch onderzoek [Psychological influences on forensic-technical investigations]. In P.J. van Koppen, J.W. de Keijser, R. Horselenberg & M. Jelicic (Eds.), *Routes van het Recht: Over de Rechtspsychologie* [Routes of the law: About Legal Psychology].





## 1. INTRODUCTION

In recent years, there have been several murder cases in the Netherlands that were initially misclassified as accidents or suicides<sup>1</sup>. These cases were only reopened after relatives raised alarm or after the perpetrator reported himself. Although the minority of deaths are criminal offences, the group of potential such cases is larger. Deaths can be ambiguous and by a wrong assessment of a death case as a suicide or an accident, a murder may be missed. Even a natural death may be misinterpreted and mistakenly identified as such, while in reality it concerns a crime.

In this dissertation, the influence of information on crime scene processing is outlined. In order to study this influence, I focused on the most difficult crime scenes, namely suspicious deaths. With death investigations, the victim can no longer give an account of what has happened and investigators have to rely on information, such as witness statements and environmental clues, to reconstruct events. Information that is initially available plays an important role in the evaluation of what has transpired and the subsequent search for traces by crime scene investigators (e.g. Innes, 2003; Resnikoff, Ribaux, Baylon, Jendly, & Rossy, 2015; Ribaux et al., 2010a; Ribaux et al., 2010b). Information may come from the crime scene itself, but also from the public or other investigating officers and can include details about the manner in which the body was found, who the victim is, and what neighbours have heard or seen. Information can shape expectations of what we see and how we see it, which in turn can determine how a case is handled.

To date, no research has been carried out that addresses the influence of information on search strategies used at the crime scene. The reason why it is important that the crime scene investigation is conducted in a more evidence-based fashion can best be illustrated by a statement of one of the police officers we interviewed:

“Your questions make me realize that you actually do everything ‘on the fly’. Of course, that applies to many things in police work. The way I figure things out does not have to be the same way my buddy does. How solid is the approach you take? How do you determine whether a case deserves a thorough investigation? How often does a general practitioner get it wrong? I do not know because it’s not my area of expertise. If I look at the numbers, I think it might be much more often than we may think.”

The aim of this thesis is to gain more insight in the role that information plays in the assessment of a crime scene and the search for and selection of traces. In the next

<sup>1</sup> E.g., HR 15 december 2015, ECLI:NL:GHARL:2015:9555; Rechtbank Noord-Nederland 24 november 2015, ECLI:NL:RBNNE:2015:5389.

section I will describe how crime scene investigators conduct the investigation of a crime scene. The section is followed by a discussion of cognitive bias and a description of the cognitive mechanisms that underlie decision-making at the crime scene.

## 2. FORENSIC INVESTIGATION AT THE CRIME SCENE

In 2016 a total of 148.997 people died in the Netherlands (Centraal Bureau voor de Statistiek, 2016). A disease caused the majority of deaths. However, 7714 deaths (5 %) had an external cause (see also table 1). If there is an external cause of death, usually the police are called in to investigate the scene (Van Amelsvoort & Groenendal, 2013). The investigation can be lengthy or short, depending on the assessment of whether a crime has been committed or not. Table 1 shows that the minority of deaths with an external cause was labelled as murder or manslaughter, usually the cases with more extensive crime scene investigations.

**TABLE 1** - Deaths with an external cause

Cause of death	Number of deaths	Percentage
Accident	5077	65,8%
Suicide	1894	24,6%
Murder and manslaughter	94	1,2%
Intention unknown	27	0,3%
Other	622	8,1%
<b>Total</b>	<b>7714</b>	<b>100%</b>

The police's Forensic Investigation Unit (*afdeling Forensische Opsporing*, FO) is responsible for recording and collecting evidence at crime scenes. The crime scene is defined as a place where an offence or incident has occurred or a location where the offender may have left physical evidence (Van Amelsvoort & Groenendal, 2013). The Forensic Investigation Unit does not only investigate suspected murder cases, but investigations also include burglaries, robberies, accidents, suicides, drugs seizures, fires and terrorist attacks. Its task is to find physical evidence, to record it, to secure it and to analyze it, or to submit it to an appropriate third-party laboratory for analysis.

The process of reconstructing a crime usually begins with a walk-through of the scene. This preliminary round is done to give the investigator a rough idea of what happened, why it happened and how it happened. During a crime scene investigation, decisions have to be made about the relevance of the available physical evidence. To reconstruct a crime, forensic investigators must first look for items of evidence formed during and by the incident, so-called crime related traces. They must then decide which of these are preserved, and finally which of them should be sent to a laboratory for

further analysis. Even at the scene itself, the crime scene investigator constantly has to reconsider whether his or her impression of what has happened matches the evidence found so far, and if necessary adjust that impression accordingly. Thus, at the scene the first priority for crime scene investigators is to find traces created during the crime and by the offender.

Textbooks on crime scene investigation are dominated by detailed descriptions of how to secure certain types of evidence (e.g., fingerprints, bite-marks, DNA, tool marks, shoeprints) without damaging or contaminating it (see, for instance, Saferstein, 2007; Van Amelsvoort & Groenendal, 2013). What these textbooks do not answer is the question of how to search for and identify crime related trace evidence and why it should be done in a particular manner. Some textbooks do recommend structured search strategies, such as screening the scene thoroughly by working in concentric circles or straight lines – methods that most likely do help finding more potential evidence, but are of no use in determining which traces are connected to the incident and which are not (e.g., Gardner, 2012; Saferstein, 2007; Van Amelsvoort & Groenendal, 2013; White, 2016). Inman and Rudin (2000) argue that critical thinking should form the core of the investigative reasoning processes. That, in fact, a key aspect of crime scene examination is the detection and recognition of relevant traces. The questions what relevant traces are and how they can be found, however, remain unanswered in the book.

Setting up universal guidelines on how to give meaning to evidence and find crime related traces is indeed difficult. Every crime scene has unique aspects that distinguish that particular crime scene on relevant points from other crime scenes. However, reasoning about where crime related traces may be found is an essential element in reconstructing crimes, as identifying and securing the right traces is the important first step in any crime scene investigation. If traces are not found, they cannot be secured and analyzed and, consequently, not be used as leads later on in the investigation or as evidence in court.

Before any item can be secured for further analysis, it first has to be spotted and recognized as a potential clue. That sounds straightforward. In reality, however, it is more complicated. It is virtually impossible to identify all the traces left by a crime, certainly if the scene is complex. There are several reasons why it is nearly impossible to identify all crime related traces. First, vestiges of other, unrelated events may disrupt the scene. For example, a home may still bear visible testimony to an earlier domestic dispute that has nothing to do with the crime now committed there. Secondly, many different events can result in crime scenes that are, on the face of it, similar. For example, the presence of large quantities of blood could be the result of a violent struggle, or a self-inflicted injury. Thus it is rare that physical evidence at a crime scene points unambiguously to one conclusion about the events that transpired. Thirdly, some physical evidence may fall so far outside our pattern of expectation that its presence is simply overlooked.

De Gruijter, De Poot, and Elffers (2016a) illustrated this in a study in which they asked forensic investigators to examine a staged crime scene, in the form of a house with three rooms. The majority of participants missed one key clue, a blood smear on a bathroom tap that led directly to one of the perpetrators, probably because there were no other signs that anyone involved had been in the bathroom and so they expected to find nothing of importance there. That expectation affected not only their search, but also what they observed.

These examples demonstrate that despite many technological and scientific advances in forensic-technical work, decision-making at the crime scene is still primarily a cognitive process. As all human decision making that may be susceptible to errors in reasoning. Cooley and Turvey (2007) point out the challenge for forensic examiners in a laboratory to interpret ambiguous stimuli (e.g., an incomplete fingerprint), but that is also true for crime scene examiners. Objects found at the crime scene can be ambiguous in that scene. Objects may be interpretable in more than one way, depending on possible explanations of what has happened at the scene. One of the factors that may influence decision-making at the crime scene is contextual information. That information, coming for instance from the emergency call or a witness statement, may play a crucial role in aiding interpretation of an ambiguous crime scene and guide the search for further evidence.

### **3. ATTENTION FOR BIAS IN THE FORENSIC COMMUNITY**

Forensic-technical work begins at the crime scene. Processing a crime scene is considered to be one of the most critical aspects of effective criminal investigations. Poorly managed scenes can result in poor quality evidence being used and increases the risk of ineffective investigations or wrongful convictions (Julian, Keltz, & Robertson, 2012). In recent years there has been increased attention for cognitive bias in the forensic science community worldwide (Committee on Identifying the Needs of the Forensic Sciences Community, 2009; ENFSI, 2015b; Forensic Science Regulator, 2015). Despite the efforts of various forensic sciences institutes and governments to create awareness of bias, a recent study by Kukucka, Kassin, Zapf, and Dror (2017) demonstrates that forensic experts consider bias as something that mainly concerns others, not themselves. Most examiners believe they are immune to bias and that willpower is enough to reduce bias.

### **4. EMPIRICAL STUDIES ON CONTEXTUAL BIAS**

Context information can give rise to expectancy effects, which affect perception and decision-making in a variety of situations. That is because people are inclined to interpret events to fit their expectations. Cognitive psychologists use various terms to describe

this phenomenon, including observer effects, context effects, and expectancy effects (Neisser, 1976; Risinger, Saks, Thompson, & Rosenthal, 2002; Rosenthal & Jacobson, 1966; Saks, Risinger, Rosenthal, & Thompson, 2003). All these terms are used to describe similar types of bias, and they may be considered interchangeable. Saks et al. (2003, p. 78) define context effects as reflections of ‘the psychological principle that the desires and expectations with which people approach the task of observation measurably affect their perceptions and interpretations of what they observe.’

In the 1960s, Rosenthal and Jacobson persuaded a group of primary-school teachers that some of their pupils were on the verge of an intellectual “growth spurt” (Rosenthal & Jacobson, 1966, 1992). That is, they were late developers but their full academic potential could emerge at any moment. That created an expectation on the part of the teachers about the future performance of the pupils in question. In fact, they had been selected at random and there were no grounds whatsoever to believe that they were about to blossom. Nevertheless, eight months later those in the select group scored better in an intelligence test than their classmates. Moreover, their teachers found them more motivated and interested than the others. In reality, though, what had happened was that the teachers’ expectations had led them to treat the selected pupils differently: they were given more time and attention, which was what actually encouraged them to perform better.

Expectancy effects are a universal phenomenon, meaning that they can also influence the forensic investigation (Cooley & Turvey, 2007; Kassin, Dror, & Kukucka, 2013; Merckelbach, Crombag, & Van Koppen, 2003; Saks et al., 2003). In one study, Dror, Charlton, and Peron (2006) demonstrated the biasing influence of contextual information in forensic science by asking five experienced fingerprint experts to assess pairs of fingerprints. The experts were unaware that they had examined the same fingerprints years earlier and had then concluded they were an absolute match. Before the stimuli were re-presented, these examiners were given information implying that the prints were not a match. After examining them a second time, only one of the five experts judged the fingerprints to be a match.

The findings of the study by Dror and colleagues caused uproar within the forensic fingerprint analysis community, because up until then this type of analysis had always been regarded as both highly reliable and objective. The results of the study demonstrated that even in the - thus far regarded as objective - domain of forensics, information can guide interpretation and decision making. Since then, other studies have confirmed that context information influences the work of forensic investigators in the laboratory, such as in handwriting comparison (e.g., Kukucka & Kassin, 2014; Miller, 1984; Stoel, Dror, & Miller, 2013), DNA matching (e.g., Dror & Hampikian, 2011), forensic anthropology (e.g., Nakhaeizadeh, Dror, & Morgan, 2014), forensic odontology (e.g., Osborne, Woods, Kieser, & Zajac, 2014), and other areas. There are other researchers,



however, who have failed to find any such effects (e.g., Hall & Player, 2008; Kerstholt et al., 2010; Kerstholt, Paashuis, & Sjerps, 2007). As a possible explanation for this null effect, Kerstholt et al. (2007) posit the fact that there are formal guidelines for shoeprint experts in the Netherlands, which they are obliged to follow. That, it is suggested, makes them less susceptible to effects of context information. In other forensic disciplines however, there are similar guidelines (see, for instance, ENFSI, 2015a for a best practice manual on fingerprint examination) and still the effects of context information on fingerprint comparisons is widely demonstrated.

Both the investigators at the scene and the experts in the laboratory start with a visual inspection of the evidence before them. Does the blood found at the scene come from the perpetrator? Does the fingerprint lifted there match the suspect's? The idea is that these assessments will be conducted as impartially as possible, but in reality the conclusion reached is always affected by a subjective interpretation of the scene and by the relative similarities between the pieces of evidence found. In other words, the decisions people make are inevitably influenced by expectations. When assessing whether two pieces of evidence originate from the same source, there is bound to be some subjectivity at work. Do the items resemble one another closely enough to conclude that they do indeed come from the same source? In many cases, there is no standardized measuring device to determine this objectively, so it is often left to the expert to make the call as to whether the evidential sample matches the reference material (Broeders & Muller, 2008). And the more ambiguous the sample – a partial fingerprint, or a complex mixture of DNA from which it is impossible to obtain clear individual profiles – the greater the scope for expectancy effects (Dror, Peron, Hind, & Charlton, 2005).

A proposed solution to mitigate the detrimental effect of context information in forensic comparisons is analysing 'blind' (i.e. without context information; e.g., Dror, 2013). Whilst that indeed may be an effective strategy in forensic laboratory work, the work of a crime scene investigator is quite different. Information is essential to guide the search at a crime scene. A scene can be extensive (e.g., a large house, a forest) and information may help to find and interpret traces. Furthermore, crime scene investigations can never be totally blind as the scene as a whole entails contextual information as well. Thus, removing contextual information is not only impossible, but may even be counter-productive to the crime scene investigation. Lessening contextual information would reduce the efficiency of processing the crime scene. Therefore, recommendations have been made to focus on the development of procedures to mitigate bias and recent research has been focussing on managing rather than eliminating contextual information in a forensic setting (e.g., Charman, Kavetski, & Hirn Mueller, 2017; Osborne, Taylor, & Zajac, 2016).

## 5. EXPECTANCY EFFECTS AT THE CRIME SCENE

Expectations can both affect the assessment of individual pieces of evidence, as well as the interpretation of the crime scene as a whole. The perceived value and significance of potential evidence also depends upon what else is known about the crime. For example, the fact that a person's DNA is found at the scene does not necessarily mean that he or she is the perpetrator – only that he or she was present at some point in the fairly recent past. And even that does not necessarily have to be true. Unlike fingerprints, DNA transfers easily from one place to another. Assessment of the likely relevance of an object or other possible piece of evidence begins at the scene, with the forensic investigator considering whether it might be related to the crime even before it is secured.

Together with other known facts about the crime, the evidence collected at the scene generates a story relating to what could have happened. Details obtained from uniformed officers, for instance, can provide the investigator with a context for the interpretation of their own finds.

Pennington and Hastie describe how jurors in a trial try to construct a coherent narrative incorporating all the evidence they have heard in order to envisage the most likely scenario for the events they are considering (Pennington & Hastie, 1991). Detectives at a crime scene do something similar in an effort to give meaning to all the information they are presented with. However there is rarely one clear story that fits the evidential picture before them (see also Crombag, Van Koppen, & Wagenaar, 2006; De Poot, Bokhorst, Van Koppen, & Muller, 2004; Van Koppen, 2011). Instead, they have to explore various different scenarios in their attempts to interpret the situation. Only after thorough investigation of all these possibilities are they left with the one most likely to explain what happened. There is a danger, however, that they become too focused on one particular scenario too early, causing them to dismiss feasible alternatives. It is well documented that people distort responses in favour of a chosen alternative after a decision has been made in order to reduce cognitive dissonance, the discomfort people experience when they simultaneously hold two or more contradictory beliefs (Elliot & Devine, 1994; Festinger, 1957).

Once such an interpretation starts to dominate the inquiry, so-called confirmation bias can set in: investigators go in search of information consistent with their favoured scenario and ignore anything which runs counter to it (Nickerson, 1998). Once they have formed an opinion, people find it hard to let go of even when presented with facts that clearly refute it. The tendency to maintain a belief, despite new information that contradicts it is known as belief perseverance. Belief perseverance and confirmation bias are mutually reinforcing. In a criminal investigation these phenomena are also referred to as tunnel vision (for an overview see Koehler, 1991). Even at the scene of a crime, their combined effect can be significant, causing important clues to be missed or

misinterpreted because they are incompatible with the presumed course of events. This was previously illustrated by the case of the blood smear on the bathroom tap, which most of the investigators overlooked (De Gruijter et al., 2016a).

Research has indicated that crime scene investigators tend to look primarily for incriminating evidence, not exonerating material. Crime scene investigators are focused on finding traces of those responsible for the crimes they look into (De Gruijter, De Poot, & Elffers, 2016b). This may seem logical – police work is about catching offenders – but it is actually an approach fraught with risk. With that attitude, evidence can easily be either misinterpreted as incriminating or erroneously dismissed as insignificant because the investigator does not expect it to come from the perpetrator, even though it does.

## **6. THE CURRENT THESIS**

To date, little empirical research has considered the influence of prior information on decision-making at the crime scene. Arguably the first step in a criminal investigation, the crime scene investigation has not been examined in research on context effects. It is unclear whether and to what extent prior information influences the perception and interpretation of a crime scene. It may be expected that contextual effects not only influence hypothesis testing, but also assessment and interpretation of forensic evidence at the scene. Likewise, there has been increased attention for the role of forensic intelligence, or investigative information, in the forensic community and the transference of this type of information from the forensic laboratory to court, but also in the forensic community there is a lack of knowledge of the role of contextual information on the investigation of a crime scene.

In the current thesis I aim to fill this gap with four empirical studies addressing that issue. The main question addressed is: If and to what extent does prior information influence the interpretation of a crime scene and the search for evidence? To answer the research question, knowledge of cognitive psychology is applied to the forensic-technical context. I have conducted interviews and used ambiguous crime scenes of death investigations to examine the research question with an experimental design. Before presenting the sub-questions and corresponding chapters, some of the cognitive mechanisms that underlie decision-making at the crime scene are outlined.

### **6.1 Theoretical framework**

Thus far the majority of studies in which the role of contextual information on decision-making in a forensic context was studied, focussed on trace comparisons in the forensic laboratory or on the assessment of evidence in the criminal investigation or in court by jurors (e.g., Ask, 2006; Dror, 2011; Dror et al., 2006; Osborne et al., 2014). In the following sections the cognitive mechanisms that underpin these types of decision-making are

explained and applied to decision-making at the crime scene. I will thus use knowledge from cognitive psychology as a starting point in the current thesis.

In recent years there has been increased attention in the forensic research community for forensic intelligence (e.g., Ribaux et al., 2010a; Ribaux et al., 2010b) and for decision-making at the crime scene (e.g., Bitzer, Ribaux, Albertini, & Delémont, 2016). Although these papers also address the use of information in the criminal investigation I will not focus on this line of research in the current thesis for two reasons. (i) These papers mainly consider the crime scene solely as a location where traces can be recovered, rather than as the basis for the reconstruction of events that may be related to a potential crime. Hence, the focus is on trace evidence and covers the road that those traces follow from crime scene to court. (ii) They describe theoretical models rather than empirical studies.

### **6.1.1 Perception**

The interpretation of a crime scene is driven by the same 'bottom up' and 'top down' perceptual and attentional processes that guide the interpretation of any other kind of scene (e.g., Vo & Wolfe, 2012; Wolfe, 1994). For example, attention may be directed 'bottom up' by the properties of the stimulus (e.g., bloodstain on white floor) and other times it may be directed 'top down' by the observer's goals and beliefs (e.g., they have been called to a house where there have been reports of domestic violence previously). These two attentional processes interact to determine the focus of attention (Egeth & Yantis, 1997; Theeuwes, 2010).

Contextual information can shape our perception particularly when a stimulus is ambiguous, as is the case with visual illusions (Balcetis & Dunning, 2006; Scocchia, Valsecchi, & Triesch, 2014). The early psychological work on visual illusions shows that prior information (e.g., a preceding series of pictures) can bias our perception of visual scenes – even if we are aware of the source of the bias (e.g., G. H. Fisher, 1968; Gregory, 1968). Furthermore, a large body of research has demonstrated that contextual information affects the efficiency of information search and the recognition of objects. For example, objects are more easily recognized when they are presented in a coherent scene with other related objects than when they are presented in a context with unrelated objects (e.g., Auckland, Cave, & Donnelly, 2007; Bar, 2004; Biederman, Mezzanotte, & Rabinowitz, 1982; Palmer, 1975). Although these studies provide information on how information can influence perception there are some important differences with searching for evidence at the crime scene. Classical visual search experiments usually involve the search for a target item in a static scene, mostly a computer screen (Wolfe, 2012). Looking for evidence in a crime scene is much more dynamic. Furthermore, when the investigation starts it is unknown what the 'target items' are and how many of those items are present at the crime scene, as none of the investigators were present at the time the crime was committed.

These more dynamic search strategies were studied by Baber and Butler (2012), who conducted an experiment investigating search strategies of expert and novice crime scene investigators in simulated crime scenes. They found that experts and novices perceive a crime scene differently. Novices explored the scene in terms of the objects that are present in the crime scene, whereas experts consider the evidence analysis that can be performed as a consequence of the examination.

Although Baber and Butler (2012) found differences in the way experts and novices perceive a crime scene it can be argued that both search strategies are mainly bottom-up driven. There is, however, evidence that top-down guidance of attention can be even stronger than bottom-up guidance. In 1999, Simons and Chabris conducted a now famous experiment. In that experiment observers were asked to count the passes in a ball passing game. At one point a human in a gorilla suit walks through the game. Approximately half of the observers failed to notice the gorilla while focusing on the ball passing. The results implicate that we perceive and remember only the objects and details that we pay attention to. The error of perception that results in not noticing unexpected objects is called inattentional blindness. When people pay attention to a particular area or object in their visual field, they tend not to notice unexpected objects, even when those objects are salient, important and appear right in front of them (Simons & Chabris, 2010).

More recently this experiment was replicated in a medical setting. The researchers asked radiologists to perform a lung nodule detection task. Results showed that 83% of radiologists did not see the gorilla hidden in the photographs. The researchers also measured eye movements with an eye-tracker. This revealed that the majority of those who did not see the gorilla had, nevertheless, looked directly at the location of the gorilla (Drew, Vo, & Wolfe, 2013). These results demonstrate that not only laypersons or novices are vulnerable to inattentional blindness, but experts are as well.

The experiments that are described above demonstrate that people can focus strongly on what they expect to see, thereby overlooking other stimuli that stand out. When crime scene investigators are sent to a crime scene with the idea that they are going to investigate a suicide, it is possible they fail to see evidence or traces that indicate that the event was an accident, or even a murder, rather than a suicide. Blindness for unanticipated evidence is also demonstrated by (De Gruijter et al., 2016b). Expectations do not only affect what we see, but can also influence how we interpret what we see. Bressan and Dal Martello (2002), for instance, showed test subjects photographs of two persons in each case an adult and a child, and asked them to rate how closely they resembled one another. When told that the pair was parent and child, people were more likely to see a resemblance than when they thought the two were unrelated.

### 6.1.2. *Heuristics*

Many early decision-making theories are based on economic utility theory. That theory is based on the assumption that people are rational decision makers. However, real-world inferences are made in situations where there are multiple competing demands on our cognitive capacities. These constraints are ignored by classical models of rational decision-making (Edwards, 1954), which assume unlimited time, knowledge and cognitive capacity to make the most optimal decision (Gigerenzer, 2001). Before and during their time at the scene, crime scene investigators are overloaded with information that they have to process as best they can. The physical evidence is by no means the only source of such information. Before he even enters the scene of, say, a murder, the investigator is typically briefed by uniformed police officers about how the body was found, who the victim is and any other known details of the crime. All of this can help in reconstructing the incident, but it may also influence the investigator's decisions and interpretations.

Moreover, experienced crime scene investigators develop routines that can affect their approach of the scene and the search for trace evidence. Gigerenzer, Todd, and the ABC research Group (1999) reasoned that people tend to rely on heuristics as a fast and frugal mechanism to make decisions in uncertain situations in order to help them to solve problems quickly and intuitively. Heuristics are problem-solving strategies to address a specific problem and can be based on previous experiences with similar problems. These heuristics enable us to organize and prioritize large amounts of information and draw conclusions also if the information is incomplete or ambiguous.

An example of a heuristic that may influence the interpretation of a crime scene is the availability heuristic: events that are more easily remembered are judged as being more probable than events that are less easily remembered (Gigerenzer et al., 1999; Tversky & Kahneman, 1974). So, for example, investigators may interpret a crime scene based on the most accessible information available at the outset of the investigation, namely the context information that is provided to them. Lichtenstein, Slovic, Fischhoff, Layman, and Combs (1978) assessed how well people can estimate the frequencies of lethal events that may occur in life (e.g., accidents, diseases, homicides, suicides). They found that availability was the key explanatory concept on judgments of risk frequency. They asked participants to judge the mortality rate associated with a wide range of risks, such as motor vehicle accidents and lung cancer. Frequency judgments were elicited from each participant in two ways: Presented with a pair of risks, participants were first asked to indicate of which risk a randomly selected person would be more likely to die. Furthermore, participants were asked to estimate how many times more likely a person would be to die of that risk compared to the other risk. Other participants were asked to estimate the mortality rate of each individual cause of death in an average year. Results revealed that people have the tendency to overestimate small frequencies

and underestimate larger ones. In a later review, Slovic, Fischhoff, and Lichtenstein (1982) emphasized that frequently occurring events are generally easier to imagine and recall than rare events. Therefore, availability is often an appropriate cue to event frequency. The papers by Lichtenstein et al. (1978) and Slovic et al. (1982) demonstrate that availability is actually defined by two effects that intertwine. On the one hand the frequency effect for more common cases, and on the other hand the prominence of - and with it the memory for- less frequent events that are more exceptional and hence generate more attention.

Although heuristics can be an efficient way to process large amounts of information they may also lead to errors, or biases, in judgment, especially when prior expectations exist. That may be explained by the fact that it involves classifying information into categories based upon previous experiences, or stereotypes (Gigerenzer et al., 1999; Kahneman, 2012; Tversky & Kahneman, 1974). Similarly, forensic investigators may draw upon their past experience to categorize new crime scenes and so expedite their search for evidence. The question, though, is whether this leaves them receptive to information that contradicts with the way they have classified what they see.

### **6.1.3. Schemas**

Contextual information in a criminal investigation can include physical evidence, the crime scene itself, statements from witnesses, victims or suspects, and data from police records. The information may be (intentionally or unintentionally) ambiguous, incomplete, contradictory or irrelevant. The task of the crime scene investigator is to interpret and evaluate relevant information and to investigate the crime scene while ignoring irrelevant information. That task involves complex problem solving and reasoning. Investigating a crime scene where there may be limited information, is therefore a process of decision-making under uncertainty. One of the factors that can affect information processing at the crime scene are schemas.

World knowledge and information from previous experiences can be used to interpret new situations. The organised collections of information stored in long-term memory are called schemas that help guide the perception and interpretation of information in the environment (Bartlett, 1932; Hastie, 1981). They also provide a framework for retrieving information from memory (e.g., Alba & Hasher, 1983). Schemas can thus effectively guide attention to areas or aspects of an event that are thought to be relevant (Tuckey & Brewer, 2003). On the other hand, what is perceived may be incorrectly interpreted in a way consistent with the schema (De Poot et al., 2004; Johnson-Laird & Wason, 1977). Thus schemas may help or hinder the reconstruction of a crime scene.

The more experienced a crime scene investigator is, the more schemas he may have to draw on. Schematic knowledge may impact the way they assess a crime scene and may therefore increase the chances of finding traces.

A theory that may explain the way in which schemas influence decision-making is the recognition-primed decision theory of expert judgment by Klein (1989, 1993, 1997). In naturalistic decision making the way in which experts make decisions in real-life environments, characterized by uncertainty, time pressure and high stakes is studied (Klein, 2008). For instance, if an experienced crime scene investigator has to investigate a burglary and has successfully found traces at specific locations during previous investigations of burglaries, he or she is likely to draw on this previous experience, which is consolidated in a schema, and to search for and select traces in similar areas (Baber & Butler, 2012).

A theoretical approach that originates from naturalistic decision-making is investigative sense making (Ormerod, Barrett, & Taylor, 2012). That is, making sense of the information available to determine, for instance, what crime may have been committed and where evidence may be found. Sense making is defined as the “deliberate effort to understand events” (Klein, Phillips, L., & Peluso, 2007, p. 114). Sense making builds on the expert’s cognitive schemes and is thus not only limited to problems an expert has solved previously, but can also include making sense of complex and novel scenes. The expert can use his skills and knowledge to make sense of the situation by creating a narrative or story of the crime to search for and interpret evidence. A key feature of the theory of investigative sense making is that the expert is able to create narratives that go beyond the immediate evidence based on his schemas. This rich narrative subsequently allows the expert to test his hypotheses and search for alternative hypotheses (Ormerod et al., 2012).

#### **6.1.4. Narratives**

Reconstructing a crime involves more than simply summing up the evidence at the scene. Bennett and Feldman (1981) were the first to propose that the criminal trial is organized around storytelling. According to these researchers a story is organised around a central action. The rest of the story serves as the context to make the central action plausible. A few years later the story model was introduced as an explanation based theory of decision-making by jurors (Pennington & Hastie, 1986). The rationale behind the model is that jurors construct a narrative story to organise and explain trial information. The authors argue that when the body of evidence relevant to a decision is “large, complex, and the implications of its constituents are interdependent, the decision process is explanation based” (Pennington & Hastie, 1992, p. 189). A distinctive assumption of the model is that decision makers reason about the evidence in order to construct a representation and that this representation is an interpretation of the original evidence. The representation, and not the evidence itself, is the basis of the final decision (Pennington & Hastie, 1993).



A good story consists of a central action and a context that allows for an easy interpretation of that action. Wagenaar, Van Koppen, and Crombag (1993) have built on the story model approach and proposed the anchored narratives theory. According to that theory, legal decisions should be based on stories that have to be anchored in common sense knowledge. A well-anchored narrative is nested in several sub-narratives. These sub-narratives are more detailed and can be arranged hierarchically.

Constructing a narrative can help crime scene investigators to organize the information. In both of the narrative models described above, meaning is assigned to evidence through the incorporation of that evidence into one or more plausible stories about what happened (Pennington & Hastie, 1986, 1992, 1993; Wagenaar et al., 1993). For crime scene investigators meaning can be assigned to trace evidence in the same way, namely through the incorporation of the trace evidence into one or more plausible stories (e.g., bloodstains could be the result of a violent assault, or a self-inflicted accident) to make sense of the evidence (Baber & Butler, 2012; Baber, Smith, Cross, Hunter, & McMaster, 2006). Previous research has demonstrated that forensic experts make sense of evidence by reconstructing the actions that may have led to the image produced. As a consequence experts tend to recover more forensic evidence than a novice (Schraagen & Leijenhof, 2001).

The elements that are the basis of the reconstruction of the crime are often based on answers to the seven golden criminalistic Wh-questions (De Poot et al., 2004; Gross, 1893). These are questions starting with the words who, what, where, when, what with, in what way, and why that are used as a framework to reconstruct a crime. Receiving answers to those questions may help to verify or falsify hypotheses about what has happened, fill out the missing elements and construct the most plausible narrative.

#### **6.1.5. Information search and feedback**

Asking questions to help formulate a hypothesis and solve a problem is not only used in forensic science. A domain that has parallels with the forensic domain is the medical domain. Clinical questions, for instance, can help with the information search in medical decision-making (e.g., Haroon & Phillips, 2010). In both domains information has to be gathered to test the probability of a number of hypotheses and rule out all but one. For both crime scene investigation and medical diagnostics, relevant evidence has to be weighed and integrated in the decision making process. And lastly, in both domains the information can come in a variety of forms (e.g. a patient's symptoms, medical examination and medical history vs. evidence at the crime scene, witness statements). It is the task of the expert (medical doctor or crime scene investigator) to determine which information is disease or crime relevant and what information is needed in order to make a correct 'diagnosis' (Bornstein & Emler, 2001). Both clinical reasoning and forensic reasoning share a susceptibility to cognitive bias, which, amongst other things, may be

explained because in both domains one has to reason backwards from effect to cause. Furthermore, research in both fields indicates that contextual information significantly influences decision-making (see for instance Bornstein & Emler, 2001; Lockhart & Satya-Murti, 2017).

People tend to use information they have at their disposal as a framework to interpret and select new information. The information that is used can be given to them (e.g. prior information), can be based on their own experiences and expectations (e.g. schemas) or can be actively gathered (e.g. asking questions). The importance of information in the criminal investigation process has been stressed in the literature (e.g., Innes, 2003), but little is known about what information investigators search for, and need, in order to reconstruct events at the crime scene. Furthermore, it is difficult to assess which information is correct or relevant and which is not in the early stages of an investigation. How the search for and use of information should be organized in investigative practice therefore remains a challenge (De Poot, 2011).

## 6.2 Overview of chapters and research questions

Having outlined the most relevant cognitive mechanisms influencing decision-making at the crime scene I will next provide an overview of how the main research question - If and to what extent does prior information influence the interpretation of a crime scene and the search for evidence? - Was addressed in this thesis. Before this question can be answered we first have to understand what kind of information crime scene investigators receive before they start the investigation of a crime scene. Furthermore, the influence of information on the interpretation of a crime scene and the selection of traces should be assessed. Finally I will examine how the potential influence of context information is related to training and experience. In order to answer the main research question I developed four sub-questions. Each chapter focuses on one of the sub-questions.

1. What kind of information is gathered and transferred before a crime scene investigator enters a scene?
2. What kind of information is necessary to make a reconstruction of events at the crime scene?
3. What is the influence of prior information on the interpretation of an ambiguous crime scene and the search for traces?
4. What is the role of expertise in the assessment of an ambiguous crime scene and the search for traces?

### 6.2.1. Chapter 2

In order to gain more insight in current practice, it first has to be established what current practice constitutes. The first sub-question therefore concerns what kind of

information is gathered and transferred by various parties before it reaches the crime scene investigator and secondly how the information is transferred. This in order to gain more insight in i) the information that is considered necessary before entering a crime scene and ii) identifying potential omissions and additions in that information before it reaches the crime scene investigator. In chapter 2, I aim to answer this question by interviewing relevant parties in the starting phase of the criminal investigation, namely emergency call responders, forensic team leaders and crime scene investigators. The main focus of the study is on the type of information that is gathered and transferred, the role of bias and the recording of information.

### **6.2.2. Chapter 3**

Chapter 3 builds on Chapter 2 by providing additional insight in the information that is needed to reconstruct events at the crime scene. In this chapter it is described in more detail what kind of information is considered necessary to reconstruct an event. The aim of the study was to investigate how the provision of context information and the ability to ask questions and obtain feedback affected participants' interpretation of an ambiguous crime scene. Participants were randomly assigned to one of four conditions and assessed two photographs of the same crime scene. Afterwards they wrote a narrative about what they thought had happened at the scene.

### **6.2.3. Chapter 4**

In Chapter 4 the influence of information on the interpretation of an ambiguous crime scene is assessed in more detail. In this chapter an experimental study is presented in which participants that were experienced crime scene investigators were provided with a 360° panoramic photograph of an ambiguous mock crime scene. The victim may have committed suicide or was murdered. Participants either received prior information indicating suicide, prior information indicating a violent death, or they received no prior information. Participants were asked about what they thought had happened at the scene of the crime, both at the initial assessment of the scene and at the end of the investigation when they were asked to describe the most likely scenario. Furthermore, they were asked to write down a list of traces they wanted to secure. This chapter provides insight in the role that contextual information plays in the interpretation of a crime scene.

### **6.2.4. Chapter 5**

The experimental study presented in Chapter 5 builds on the findings presented in Chapter 4. In this chapter the role of expertise in the assessment of an ambiguous crime scene and the selection of traces is examined. In this study applied forensic science

students assessed the same ambiguous mock crime scene that was described in Chapter 4. The data that were obtained from the forensic science students were compared with the data from the experienced crime scene investigators. The students had limited practical experience with crime scene investigations, but had theoretical knowledge of cognitive bias. The experienced crime scene investigators had limited knowledge of cognitive bias, but extensive experience with crime scene investigations. The aim of this study is to gain more insight in the role of theoretical knowledge of cognitive bias as a protective factor against it.

### **6.2.5. Chapter 6**

Based on the answers obtained to the sub-questions, I will outline the knowledge I gained regarding the influence of information on the crime scene investigation. In Chapter 6 I will summarize the information obtained in the four studies I have conducted and discuss the findings. In the rest of the discussion, remaining gaps in the literature are identified, the strengths and weaknesses of the current thesis are discussed and future research needs are identified.

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